DOCUMENT RESUME

ED 096 005 PS 007 453

AUTHOR Wilmshurst, Lin[illegible] A.; Rubin, Kenneth H.
TITLE Training Preschoolers to Understand Left-Right and Spatial Relations.
PUB DATE [74]
NOTE 23p.

EDRS PRICE MF-$0.75 HC-$1.50 PLUS POSTAGE
DESCRIPTORS Cognitive Development; Complexity Level; *Concept Formation; Data Analysis; Developmental Psychology; *Logical Thinking; Post Testing; *Preschool Learning; Pretests; Self Concept; *Spatial Relationship; *Training Techniques; Transfer of Training
IDENTIFIERS *Left Right Concepts

ABSTRACT

Twenty 4-year-old children were randomly assigned to one of two experimental groups or to a control group in an attempt to determine whether or not training of left-right relational concepts would improve (1) the subjects' left-right relational skills and (2) their ability to better perform on tasks of spatial perspective. All children were administered a pre- and posttest of left-right relations and spatial perspectives. The experimental groups (n=5 and n=3) received seven carefully planned lessons based on cognitive conflict procedures. Results indicated moderate pre- to posttest gains in left-right and spatial skills for the experimental groups only. Educational implications of the training procedures are briefly discussed. (Author/CS)

ED 096005

U S DEPARTMENT OF HEALTH
EDUCATION & WELFARE
NATIONAL INSTITUTE OF
EDUCATION
THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL NATIONAL INSTITUTE OF EDUCATION POSITION OR POLICY

BEST COPY AVAILABLE

Training Preschoolers to Understand Left-Right and Spatial Relations

Linda A. Wilmshurst and Kenneth H. Rubin
University of Windsor University of Waterloo

The understanding of left-right conceptual relationships has been emphasized as one of the principal obstacles to the development of logical reasoning (Piaget, 1928). Ontogenetically, there appear to be three global levels in the development of left-right transpositional skills (Elkind, 1961; Piaget, 1928): (a) In the first stage the child defines left and right concepts using his own body as the sole frame of reference; (b) at the second level, he is able to correctly identify the lefts and rights of other persons, and can deal with the left-right relation between two objects, provided they are related to another person, and (c) by the third stage, the child has a completely abstract conception of these relational terms.

Related to the distinction between the first two stages described above is Piaget and Inhelder's (1956) finding that young children are spatially egocentric, that is, children often confuse their own points of view with those of other persons. For example, in the now famous "three mountain"

PS 007 453

BEST COPY AVAILABLE

xperiment (Piaget and Inhelder, 1956) children were asked to match a model of three papier mache "mountains" using an identical set of materials. Subsequently, the children were asked to construct their display in such a way that it matched the "viewpoint" of a doll which was placed at a position about the model different from that of the subjects'. The egocentric child tended to match the model using his own viewpoint as the sole referent. Piaget and Inhelder noted that among the most common errors made by children who either egocentrically or incorrectly matched the model was the confusion of left-right relationships. Children often mistook their own left and right perspectives with that of the doll's.

Recent investigations (e.g., Cole, Costanzo, & Fernhill, 1973) have supported the Piagetian premise that the mastery of left-right relationships is a stepping stone to nonegocentric perspectivism. These findings and recent reports that preschool children have elementary concepts of the existence of perspectives (McCluskey, Sims-Knight, & Flavell, 1971) led to our belief that preschool-aged children could be trained to improve upon existing left-right relational concepts, and that, as a consequence, their spatial skills. Drawing impetus from Flavell's (1971) recent comments that the training of such Piagetian role-taking skills merits more attention than it has thus far

BEST COPY AVAILABLE

received, we set out to discover (a) whether or not we could significantly improve the left-right transpositional skills of preschoolers and (b) whether or not the successful training of the former skills would improve the children's abilities to conceive perspectives from other points of view.

The training procedure derived from Piaget's (1926) suggestion that cognitive conflict, or the presentation of conflicting points of view, is a necessary condition for the evolution of mature spatial decentration skills. To Piaget, such conflicts provoke a cognitive "disequilibrium" which leads the child to intrinsically seek higher levels of logical functioning. Unlike previous successful "conflict-disequilibrium" studies (e.g., Murray, 1972; Shantz and Watson, 1971) the setting of the present investigation was a preschool classroom rather than an experimental laboratory. In natural group settings, conflicting viewpoints were instituted through teacher-initiated peer interaction and through the use of testing materials that were designed to provide self-correcting and often discrepant feedback.

Method

Subjects

The subjects were 20 Caucasian four-year-old preschool children (9 females and 11 males) attending a day care centre in a large city in Western Ontario. The subjects

BEST COPY AVAILABLE

were randomly assigned to one of two groups: (a) an experimental group (n=8) trained for relational judgment and (b) a control group which received no training (n=12). Four additional subjects who had been assigned to the experimental group were eliminated from the study: one for withdrawal from the centre and three due to illness. The mean age of the children was 50.4 months (SD=8.6 months).

Materials and Procedure

All subjects were individually administered tests of left-right relational skills and spatial skills one week prior to (pretest) and one week following (posttest) the training sessions. Testing was conducted in a single session, in a small, quiet room within the day care centre. Left-right testing always preceded spatial testing.

Left-right relational skills - The pre-and posttest questions were adapted from Piaget's (1928) original study designed to judge the child's ability to distinguish left and right. The child was brought into the experimental room and after a brief warm-up period, the experimenter:

1. Asked the subject to (a) show her the subject's right hand, (b) left hand, (c) right leg, (d) left leg.
2. Sitting beside the subject, the experimenter asked the child to (a) show her the experimenter's right hand, (b) left hand, (c) right leg, (d) left leg.

PS 007453

BEST COPY AVAILABLE

3. Sitting across from the subject, questions 2 a, b, c and d were repeated.

4. Placing a coin on the table to the left of a pencil relative to the child, the experimenter asked (a) whether the penny was on the right or the left hand side, (b) whether the pencil was on the right or the left hand side. (Reversing the items, the same questions were repeated).

5. Facing the child, the experimenter placed a coin in her right hand and a watch on her left arm and asked (a) whether the penny was in the right or left hand, (b) whether the watch was on the right or left arm. Turning her back to the child, questions 5 (a) and (b) were repeated (Thus 5(c) and (d)).

6. The child sat facing a table on which a penny was to his right, a pencil to his left, and a key in the middle. The experimenter asked (a) "Is the pencil to the left or to the right of the key?" (b) "Is the key to the left or to the right of the penny?" (c) "Is the penny to the left or to the right of the pencil?" (d) "Is the key to the left or to the right of the pencil?" (The child was then seated at the opposite side of the table). Questions 6(e) and (f) were identical to questions 6(a) and (b). Then, (g) "Is the penny to the

BEST COPY AVAILABLE

left or to the right of the key?" (h) "Is the pencil to the left or to the right of the key?"

The pre- and posttest for relational judgment consisted of 28 questions. One point was assigned for each correct answer.

Spatial egocentrism - Following the left-right relations testing, the experimenter sat the child at a small table. The child sat in a position of 0^0, while three empty chairs were positioned at 90^0, 180^0, and 270^0. The experimenter then showed the child a box (6" square) that had pictures pasted on each side. The pictures included a car, a dog, a house, and a drum. The child was asked to identify each picture (the experimenter corrected any mistakes). The experimenter then gave the child a 3" square box identical to the larger one. The larger box was placed in the center of the table such that the picture of the drum was facing the child (0^0), the dog was on the subject's right hand side of the box (90^0), the car was opposite the subject (180^0) and the house was on the subject's left hand side of the box (270^0). The smaller box was then placed in front of the subject. The experimenter:

1. Asked the subject to take his box and (a) match his own perspective of the bigger box; (b) to take his box and match the perspective of an imaginary person sitting at 90^0; (c) at 180^0, (d) at 270^0.

BEST COPY AVAILABLE

The experimenter removed the boxes and showed the subject a ball which was red on one side and white on the other. The child was asked to name the colors of the ball and the experimenter corrected or affirmed the response. The ball was then placed in the middle of the table such that the child could see the colors hidden from view if so inclined. The red side faced the child; the white side was opposite. The experimenter:

2. Asked the subject to (a) identify the color of the ball that he saw; (b) to identify the color or colors that a person sitting at 90^0 would see; (c) at 180^0; (d) at 270^0.

The experimenter removed the ball and placed a doll, facing the child, on the table. A penny was then placed to the doll's right, a small toy hat was placed in front of the doll and 4" to the left of the penny, and a toy car was put in a position to the doll's left, 4" left of the hat. The doll was oriented slightly but noticeably to the left. The experimenter:

3. (a) Asked whether the doll was looking at the penny, the hat, or the car.

The three objects were removed and replaced by a pencil, a wooden square, and a paper circle respectively. The doll was oriented to the right and the child was asked:

(b) Whether the doll was looking at the pencil, the hat, or the square.

BEST COPY AVAILABLE

Removing the three items, the experimenter placed a toy bear and a toy elephant on the table. The experimenter arranged the materials such that the doll was on the extreme left facing the bear (child's right side). The elephant was placed 3" from the bear, facing the elephant. The elephant faced the child. The experimenter asked:

(c) Who the elephant was looking at.

(d) Who the bear was looking at.

The experimenter removed all materials but the doll and presented a red and blue ball to the subject. The child was asked to confirm whether or not the ball was blue on one side and red on the other. Subsequently, the ball was placed in the middle of the table, and the doll was placed in a position at 90^0. The experimenter asked:

4. (a) The color or colors that the child saw; (b) the color or colors the doll saw; (c) and (d), The ball was then rotated 1/2 a turn and the experimenter repeated questions (a) and (b).

5. (a) and (b). The experimenter placed the doll at 180^0 and repeated questions 4(a) and (b); (c) and (d). The experimenter moved the doll to 270^0 and repeated 4(a) and (b).

The experimenter removed the ball and placed the doll at 180^0. The child was then shown a model of a papier mache village. The model consisted of a 12" circular base on

BEST COPY AVAILABLE

which were constructed a hill with a tree on it (200°), a pond with a pipe-stem bridge over it (90°), and a school house (directly in front of the child).

6. (a) The experimenter asked the child the order in which he would pass the objects on the road if he was to visit the doll (school, bridge, and hill respectively); (b) the order in which the doll would pass the objects on the road while visiting him (hill, bridge, and school respectively); (c) The experimenter provided the subject with a second model village, identical to the first one. The child was asked to watch the model; (d) The doll was placed at 180° and the child was asked to take his model and turn it until it portrayed the viewpoint of the doll facing the original model; (e) and (f) The doll was placed at (6e) and 270° (6f) and 6(d) was repeated; (g) and (h) The original model was rotated 90° and the doll was placed at 180° (6g) and 90° (6h). Question 6(d) was repeated.

The pre- and posttest for spatial egocentrism consisted of 28 questions. Each correct answer received a score of one point.

Training for relational judgment - The subjects in the training group were divided into two subgroups. Originally there were three males and three females in each of the two subgroups. However, as mentioned above, four subjects became unavailable during the first phases of training. As

BEST COPY AVAILABLE

a result the first experimental group (E_1) consisted of five subjects (three female, 2 males) and the second group (E_2) consisted of three children (one female and two males). The training groups met four times during the first week of training, and met for three sessions the following week. Each of the seven training sessions was 30 minutes in duration for each subgroup (E_1 and E_2). Training was given at the same time each day; E_1 from 10:00 - 10:30 a.m., and E_2 from 10:30 - 11:00 a.m. Each session was conducted by the senior author as part of the normal classroom routine.

The experimenter began the first session by introducing the children and herself to each other. The experimenter then said; "We are going to play some games together for a while. I would like you to give answers to as many questions as you can. Raise your hand if you know an answer. You may have to wait your turn if more than one hand is raised, so that everyone has a chance to play the games." The sessions are briefly described below.[1]

Sessions 1 and 2 - A Bell and Howell Language Master was used in the first two sessions to introduce the concepts of "same vs. different" and to illustrate how these initial concepts applied to "left vs. right" relations. The Language Master is a machine operable by children, on which sounds may be recorded and played back on 8 1/2" x 10 1/2" cards, each of which is equipped with two channels of

BEST COPY AVAILABLE

magnetic audio-tape across the bottom. Space at the top of each card permitted the graphic representation of a concept, and a corresponding sound recording of the concept. For example, during the second session, a square that was red on one half and yellow on the other was drawn on one card. The corresponding recorded statement was: "The color red is on the (pause)...left hand side." The experimenter first played the tape through for four times. Then the experimenter asked the children the following questions: "The left side of the square is?"...(red). "The color yellow is on the ?...(right hand side)." Following each answer the children were provided with the correct audio feedback, thus verifying or conflicting with their initial responses. Ten cards were constructed for each of the first three lessons.

Session 3 through 7 - During the remaining sessions, the experimenter used felt board materials, puppets, and puzzles to extend the children's understandings of left-right relations. With the felt board materials, for example, the experimenter placed either front or back view cut-outs of a boy on the felt board and asked the children to place various felt items to the boy's left or right. Following each trial, the experimenter asked the remaining subjects if they agreed or disagreed with the placement and why or why not.

BEST COPY AVAILABLE

Throughout the training sessions, the experimenter asked questions in an attempt to guide, rather than instruct the subject concerning solutions to the various problems. The experimenter provided correct answers when a new concept was introduced or when the subjects in their search for the correct solution deviated from the concept to the extent that other subjects became confused. At all times, the experimenter attempted to direct the subject's attention to the lesson proper and to maintain this attention by asking the subjects to correct and point out the mistakes of the other subjects. When a child responded correctly, the experimenter asked why the subject gave that particular response in an attempt to clarify the subject's understanding of the concepts. If a subject was incorrect, the experimenter also asked why the child gave that response in an attempt to allow the other children to see the conflict. It was assumed that conflicting responses would initiate a better understanding of the concepts presented.

Results

All data within the experimental groups and within the control group were combined since t-tests revealed nonsignificant sex differences. Pre- and posttest means and standard deviations for the experimental and control groups are presented in Table 1.

BEST COPY AVAILABLE

Insert Table 1 about here

Statistical analyses (t-tests) revealed no significant pretest difference to exist between the two groups on the left-right measure. Pre- to posttest improvements on left-right relations was significant for the experimental group only ($t=2.76$, $df=7$, $p<.05$). Analysis of mean change scores supported these latter data by indicating a significantly greater improvement for the experimental group as compared to the control group ($t=2.63$, $df=18$, $p<.02$).

Further analyses indicated that during the pretest, the experimental and control groups were performing at chance level on Question 4 (left and right of two objects), and below chance on Question 6 (Experimental: $t=4.42$, $df=7$, $p<.01$; Control: $t=4.93$, $df=11$, $p<.001$) thereby suggesting a confusion of left and right where objects can simultaneously be to the left and right of other objects. The experimental group performed significantly below chance on Questions 2, 3, and 5 combined ($t=5.86$, $df=7$, $p<.001$) thus confusing left and right on questions concerning "opposite" and "beside". On the other hand, the experimental group was performing above chance on Question 1 concerning their own left and right ($t=35.00$, $df=7$, $p<.001$). The control group performed

BEST COPY AVAILABLE

at chance level both on Question 1 and on Questions 2, 3, and 5 combined.

On the post-test, the experimental group moved from systematically confusing left and right to chance performance on Question 6 and Questions 2, 3, and 5 combined. Moreover, the experimental group improved from chance to above chance performance on Question 4 (t=6.00, df=7, $p<.001$), and maintained above chance performance on Question 1 (all subjects performed to criterion). The only control group change was an improvement from chance to above chance performance on Question 1. Thus there appeared to be a general overall improvement for the Experimental group, but little, if any improvement for the control group.

Finally, with regard to left-right relations, questions 1a, b, c, and d referred only to the "lefts and rights" of the subjects themselves. Moreover, the difficulty level of these items (77% correct for the experimental and control groups combined on the pretest) was much lower than the difficulty level for the left-right, "other-oriented" questions (30.04% correct). Statistical analyses (t-tests) revealed that while the two groups performed similarly on the pre- and posttests for left-right "subject-oriented" questions, the experimental group performed in a superior manner on only the posttest for "other-oriented" questions (t=2.83, df=18, $p<.02$).

BEST COPY AVAILABLE

Concerning spatial relations, the data indicated that the experimental group performed significantly better than the control group on the pretest (t=2.13, df=18, $p<.05$) and on the posttest (t=3.03, df=18, $p<.01$). In order to determine the extent of the experimental treatment effects, the pre- and posttest means within groups were compared. Since the pre- to posttest improvements for perspective (t=3.86, df=7, $p<.01$) were significant for the experimental group only, it may be assumed that the treatment did have a significant effect.

Further analyses of the spatial data revealed that both groups performed significantly above chance ($p<.001$ in all cases) for all pretest perspectives questions on which a chance level could be calculated (i.e., questions 1, 2, 3, 4 and 5). No significant differences were found between the groups on the pretest for Question 6. The mean change scores of the experimental group were significantly superior to those of the control group for Questions 2 (t=2.58, df=18, $p<.02$) and Question 6 (t=2.31, df=18, $p<.05$). While significance was not reached for the remaining questions, in all cases there was greater improvement favoring the experimental group.

Furthermore, questions 1a, 2a, 4a, 4c, 5a, 5c, 6a, and 6c for perspectives, referred only to the perspectives of the subjects themselves. The difficulty level of these

BEST COPY AVAILABLE

items (78.43% correct on the pretest) was far lower then the difficulty level for the "other-oriented" perspective questions (54.57% correct). Statistical analysis revealed that the two groups performed similarly on both types of perspectives questions on the pretest. However, the experimental group was superior to the control group on the posttest for self-oriented (t=3.11, df=18, $p<.01$) and other-oriented (t=3.24, df=18, $p<.01$) perspectives questions.

Finally, the implied correlation between performance on left-right relational tasks and the perspectives measures was supported in the data. A correlation coefficient calculated between the two measures for both groups combined was significant both for the pretest (r=.75, df=18, $p<.01$) and for the posttest (r=.66, df=18, $p<.01$).

Discussion

The purpose of the present study was (a) to investigate whether or not preschoolers could be trained to improve upon their initial understanding of left-right relations, and (b) to discover whether or not such training improved their abilities to take the spatial viewpoints of others.

The data indicated that the training procedure was only moderately successful in improving left-right transpositional skills and spatial, role-taking abilities. Concerning the first purpose of the study, the results revealed that the overall performance of the experimental

BEST COPY AVAILABLE

group on the posttest for left-right relationships was significantly superior to that of the control group. Further analyses showed that only the experimental group improved significantly from pre- to posttest. One might question whether or not the treatment actually did have an effect since the improvement of the experimental group was generally from a level of outright confusion of left and right to only a chance performance on left-right questions (i.e., Questions 6 and 2, 3, and 5 combined). Since outright initial confusion on Questions 2, 3, and 5 indicated an egocentric response, one may tentatively conclude that perhaps the treatment made the children at least partially aware that others have viewpoints different from their own. On Question 4, which concerned the identification of the lefts and rights of objects, the experimental group moved from chance to above chance performance.

Concerning the transfer of left-right skills to tasks of spatial perspectives, the data again indicated the superiority of the experimental group. In addition, only the experimental group showed significant improvement on this measure. These findings are tempered by the fact that the experimental group was performing in a superior fashion to begin with, i.e., there were significant pretest perspectives differences favoring the experimental group.

BEST COPY AVAILABLE

One finding of note concerned the difficulty levels of objective as opposed to subjective questions. The data revealed that questions involving the subjects' conceptions of their own "lefts" and "rights" and their own perspectives were much easier than questions involving objective perspectives. This result supported previous findings (eg. Elkind, 1961) that the child first masters subjective viewpoints and consequently develops a conception of the viewpoints of others. Interestingly, the training program significantly improved the experimental groups notions of objective spatial and left-right relations, as well as their understanding of subjective spatial perspectives. Since the pretest level of subjective left-right relational understanding was quite high to begin with (seven of the eight experimental group subjects had reached criterion on the pretest), there appeared to be little room for improvement through training.

The present study departed from the usual format of past Piagetian training studies (e.g., see Brainerd and Allen, 1971 for a recent review of conservation training studies) in two significant ways. First, it dealt with the Piagetian "social" as opposed to the "nonsocial" world. Second, the training procedure was conducted with small groups of children as part of the normal, preschool curriculum. This contrasts with the vast majority of

BEST COPY AVAILABLE

Piagetian training studies in which individual children are studied in laboratory settings. The latter departure is certainly important when conceived of in terms of immediate educational relevance.

Moreover, the present method of training was drawn from Piaget's (1926) theory itself, i.e., cognitive conflict was induced with the belief that such a procedure would aid the children to consider opposing viewpoints and alternate responses. In conclusion, it may be stated that the training procedures were only moderately successful in attaining the goals of the study.

BEST COPY AVAILABLE

References

Brainerd, C. J. & Allen, T. W. Experimental inductions of the conservation of "first order" quantitative invariants. Psychological Bulletin, 1971, 75, 128-144.

Cole, J. D., Costanzo, P. R., & Farnhill, D. Specific transitions in the development of spatial perspective-taking ability. Developmental Psychology, 1973, 9, 167-177.

Elkind, D. The child's conception of right and left. Journal of Genetic Psychology, 1961, 99, 269-276.

Flavell, J. H. The development of inferences about others. Paper presented at the Interdisciplinary Conference on our Knowledge of Person Perception and Interpersonal Behavior. Binghampton, New York, 1971.

Harris, L. J. Discrimination of left and right and the development of the logic of relations. Merrill-Palmer Quarterly, 1972, 18, 4, 308-320.

Masangkay, Z., McCluskey, K., Sims-Knight, J. & Flavell, J. The early development of inferences about the visual percepts of others. Unpublished Manuscript, University of Minnesota, 1971.

Murray, F. B. Acquisition of conservation through social interaction. Developmental Psychology, 1972, 6, 1-6.

Piaget, J. The language and thought of the child. London: Routledge and Kegan Paul, 1926.

BEST COPY AVAILABLE

Piaget, J. Judgment and reasoning in the child. New Jersey: Littlefield, Adams & Co., 1928.

Piaget, J. and Inhelder, B. The child's conception of space. New York: Humanities Press, 1956.

Shantz, C. and Watson, J. Spatial abilities and spatial egocentrism in the young child. Child Development, 1971, 42, 171-181.

Sigel, I. E. The Piagetian system and the world of education. In D. Elkind & J. H. Flavell (Eds.), Studies in cognitive development: Essays in honor of Jean Piaget. New York: Oxford University Press, 1969.

BEST COPY AVAILABLE

Footnotes

1 An extended description of the lesson plans is available from ERIC/ECE. See Rubin & Wilmshurst, Training preschoolers to understand left-right and spatial relations: lesson plans. Urbana, Illinois: ERIC Clearinghouse on Early Childhood Education, 1974.

BEST COPY AVAILABLE

Table 1

Pre- and Posttest Means and Standard Deviations for the Experimental and Control Groups

	Experimental (n=8)		Control (n=12)	
	M	SD	M	SD
Pretest				
Perspective	18.50	1.46	15.42	3.71
Left-right	10.00	5.17	10.58	7.19
Posttest				
Perspective	21.75	2.22	15.75	3.92
Left-right	15.62	5.87	10.66	6.71